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FeCu 合金の溶融凝固過程の観察

Observation of melt solidification process of FeCu alloy

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Some of alloys, typically those are the combination of a transition metal and a noble metal alloy show as a curious phase separation which is a liquid – liquid phase separation in the undercooled liquid state[1]. For the example, an iron-copper alloy is one of the alloys which show such kind of phase separation. Thus, it is expected to make a characteristic alloy structure when we utilize the feature of phase separation during the solidification. In this experiment, the gas-jet levitation method was adopted for the melting and solidifying the Fe-Cu alloys without using a vessel. The temperature profiles of the sample were observed due to the pyrometric method and the relation to the formation of microstructure were investigated.

In this experiment, spherical iron-copper alloys were prepared, whose diameter were around 2 mm. The samples were formed by the irradiation of a semiconductor laser in the glove box in which the purified Argon was filled. For the gas-jet levitation method, the conical nozzle was made of sintered boron nitride. A sample on the conical nozzle was irradiated by the semiconductor laser whose wavelength was 980 nm and max. power was 200 W. **Fig. 1** shows a schematic diagram of the apparatus which was used in this study.

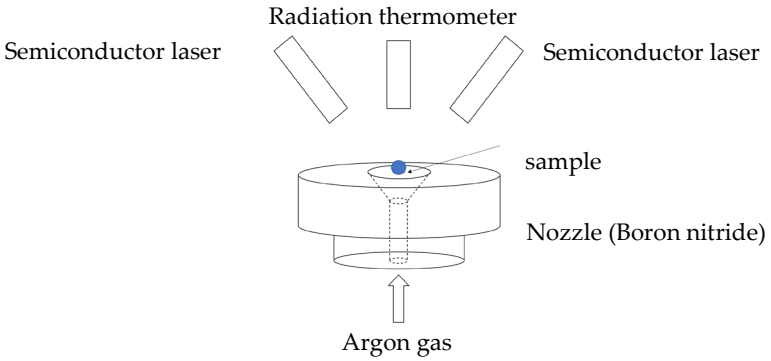

Fig. 1 schematic diagram of the apparatus

Fig. 2 shows the typical data of cooling curve of the sample temperature measured by a pyrometer. The exothermic signals were found at the temperature of 1000K, 800K and 400K. It is well known that the temperature measured by pyrometric method depends on the emissivity. In this study, the temperature calibration of this data is under the consideration because those signals should be carefully assessed to the phase diagrams.

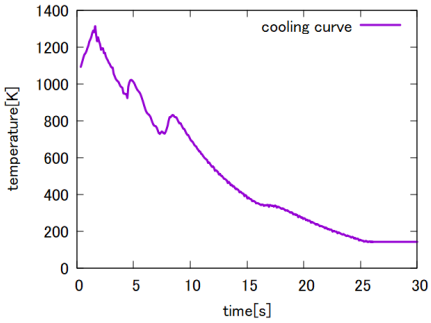

Fig. 2 The cooling curve at Fe-50 mol%Cu

The processed samples of Fe-50 mol%Cu alloy with a diameter of 2 mm were polished every 0.1 mm and observed the cross-section via a microscope. **Fig. 3** (a) is a typical photo of the cross section of the sphere at Fe-50 mol%Cu. The white phase was the Fe-rich phase and the dark phase was Cu-rich phase. The cross sections from the top of the sphere are shown in **Fig. 3** (b) using the parallel projection method.

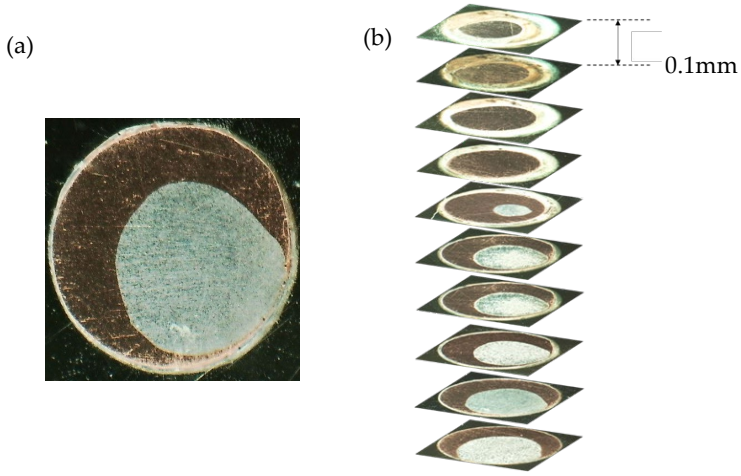

Fig. 3 (a) Examples the cross section at Fe-50 mol%Cu and (b) the cross section at Fe-50 mol%Cu using the parallel projection method

The Fe-rich phase formed almost spherical which was embedded into the Cu-rich phase. The alloy phase might be formed due to the liquid-liquid phase separation in the non-equilibrium state and coalescence of Fe-rich liquid alloy in the Cu-rich one. The mechanisms of the formation will be discussed.

References

1) C. P. Wang X. j. Liu, I. Ohnuma R. Kinuma , K. Ishida : Science, **297** 5583 (2002) 992.